

# 화재경보망과 블루투스 기반으로 위험에 처한 사람의 위치 파악

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## Localization of People at Risk based on the Fire Alarm Networks and Bluetooth

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**요약** : 선박에서 신변이상자를 신속히 발견하는 것은 안전사고로 인한 피해를 최소화하는 데 매우 중요하다. 일반적으로 실내 위치 추적 시스템을 도입하려면 선박에 새로운 인프라를 구축해야 한다. 본 논문에서는 기존의 화재경보망을 활용하여 일반적으로 스마트 기기를 지니고 있는 사람이 위험상황에 처했을 때 즉각 스마트 기기를 인식하고 위치를 파악할 수 있는 실내 위치 파악 시스템을 제안한다. 기존의 화재 감지기 및 화재 경보 시스템 제어기 등의 네트워크를 활용하기 때문에 새로운 네트워크 인프라를 구축하는 부담을 줄였다.

**핵심용어** : 실내 위치 파악, 화재 경보 시스템, 블루투스, 사물인터넷, 웨어러블 디바이스

**Abstract** : It would be very important to localize people at risk as soon as possible in order to minimize the damage. Generally the infrastructure should be deployed additionally for indoor positioning system. In this paper, we proposed an indoor localization system for people at risk using the existing fire alarm networks. The system detects the signal of smart devices of people in danger immediately and let the main alarm controller ring all alarms in vessel and display the position. Thus, the proposed system can make the burden much less to deploy additional network and infrastructure.

**Key words** : Indoor Positioning, Fire Alarm System, Bluetooth, Internet of Things, Wearable Device

## 1. Introduction

We have studied an indoor positioning system to locate persons at risk effectively using the existing fire alarm network installed in the ship. In real environments, however, more than one user smart devices should be able to communicate with a fire detector. In this paper, we have focused on making the system achieve the simultaneous connectivity with multiple devices around the alarm detectors.

## 2. Related Works

Most indoor positioning system may need complex infrastructure such as WiFi and Beacon.[1][2] That makes it difficult to apply it to existing ships and vessels. In Jeong's study[3], it is necessary to install additional routers and servers on board. In this paper, we propose a more practical system for positioning people in danger in multi-user

environments.

## 3. Multi-user Indoor Positioning System

### 3.1 System Outline

The proposed system to detect locations of people at risk needs a signal detection module connected to each existing fire detector and smart devices held by people to track the body condition. Most people have at least one smart device such as smart phone, smart band, and/or smart watch. Application operating at the smart device can gather the user's biometric data, movement status, and other environmental data to recognize the body health and safety.

The architecture of the proposed system is shown in Fig. 1. Once the smart device identifies dangerous situations of user, it sends bluetooth signals to the signal detection module located at around the smart device. The signal detection module is connected to the existing fire alarm detector on the ceiling. That receives the bluetooth signals, and activates the

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heat/smoke sensor in the fire detector. Then, the fire detector considers the activation of the sensor just as fire occurs. After that, the fire alarm network and system work just like when the fire has broken out. The main fire system controller detects the signal of the detector, makes every alarm in vessel ring, and displays the position of the activated fire detector on the panel. In commercial vessels, the main fire system controller are located usually at the bridge and the engine room. So, all crews can immediately recognize the emergency situation and location of the scene as well.

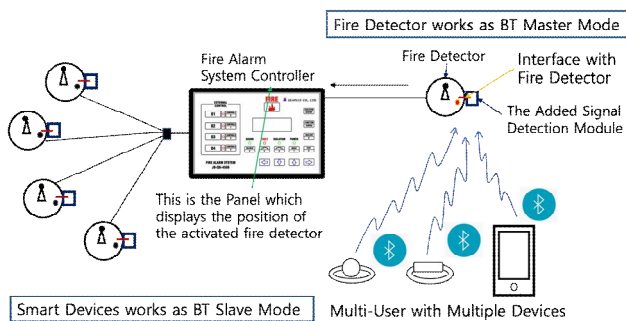


Fig. 1 System Architecture

### 3.2 Bluetooth Signal Process Module

A bluetooth (BT) signal process module (Fig. 2) is added to the existing fire detector. This module operates in BT master mode and user devices (smart devices) work as BT slaves. When at least one user's device detects the abnormal condition of the user, then the device tries to connect to one of the nearest BT signal process modules. Then, at least one fire detector can detect the emergency situation via the BT signal process module that have detected the BT signal from the device of user at risk.

## 4. System Experiment

### 4.1 System Implementation

The BT signal process module is constructed with HC-06 BT module connected to the Arduino UNO R3 board to process the BT signals. An Arduino program is implemented to identify causes of the BT signals from users' smart devices which may be lower/higher body temperature and pulse rate, or no movement of users for a long time. The program turns the relay on in the situations.

An Android application is also developed to detect the user's body condition and movement, and then send cause data through the BT wireless network.

### 4.2 Results

Application of the smart device is actually implemented to simulate the bio condition of people. If a semi-randomly generated bio-data is revealed not to be a normal value, then the smart device tries to connect to one of BT modules located around it. After connection to a BT module at the fire detector, the application sends the abnormal bio-data to the fire detector via BT. In our experiments, the BT signal process module received the data successfully. Arduino application, then, recognized the data as an emergency situation. Finally, the relay was connected immediately, and the fire detector rang. (Fig. 2)

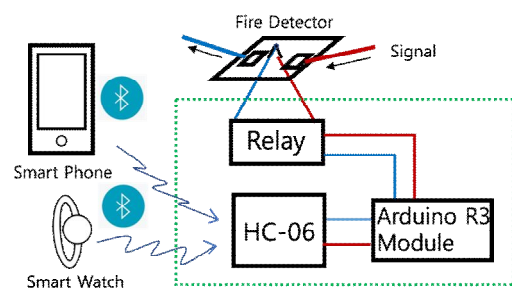


Fig. 2 Bluetooth Signal Process Module

## 5. Conclusion

We have proposed a multi-user indoor positioning system with the existing fire alarm networks and BT. The system can get causes of the emergency situation of people at risk that may rescue people more quickly and accurately.

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